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work and opinions – those based the computer model as it relates to the allocation of phosphorous loading to the major rivers and Lake Tenkiller in the Illinois River Watershed (“IRW”) and the future phosphorous loading scenarios that Dr. Engel modeled relating to the different phosphorous loadings based on changes to the amount of poultry waste that is land applied (the “Model”).¹ As shown below:

- (1) the Model was based on well-accepted hydrologic modeling theory and methodology that is part of the body of peer reviewed scientific literature for this scientific discipline,
- (2) the underlying scientific theory and methodology was reliably applied in the Model’s development and application to the IRW,
- (3) the Model is capable and has been subject to testing through its calibration and validation process,
- (4) the Model’s theory and method and the application of that theory and method has been peer reviewed as evidenced by the large body of peer reviewed literature that supports the use of the Model and the means by which Dr. Engel applied it to the IRW, and
- (5) the Model has standards and techniques that control its operation.

As a consequence the Model’s theory and methodology, as well as its application to the IRW, were reliably employed by Dr. Engel, and the opinions resulting from that work will facilitate and assist the Court’s and jury’s understanding of relevant issues that are a part of this case.

II. Discussion

A. Legal Standard.

The basis for admitting expert opinions such as that provided by Dr. Engel is Rule 702 of the Federal Rules of Evidence:

¹ It is important to note that of the ten sections and related opinions in Dr. Engel’s report, Defendants only challenge the Model work found in section 10 of his report.

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

As an initial matter, the court must determine if the expert is qualified by "knowledge, skill, experience, training, or education" to render an opinion. *Id.* In this case Defendants do not contest Dr. Engel's expertise in the subject areas of the Model or the other areas in which he will testify. Indeed, a review of Dr. Engel's experience and qualifications indicates that he is one of the leading experts in the field of watershed modeling and nutrient (such as phosphorous) water pollution from nonpoint sources. In fact, Judge Eagan selected Dr. Engel as the Court-selected expert to review the same type of modeling in the *City of Tulsa* case. *See* Exhibit A (Engel CV); Exhibit C (Engel Decl. ¶¶ 1-5); Defendants' Motion (Exhibit 3, p. 449). With regard to this issue of experience, Dr. Bierman, Defendants' retained expert concerning the Model and runoff modeling in general, admits that Dr. Engel has "...more experience in doing that type of modeling than I have." *See* Exhibit D (Bierman Depo. 331:6-12).

Next, a court must ensure that the scientific testimony being offered is "not only relevant, but reliable." *See Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 589 (1993). This is the issue raised by Defendants' motion when they challenge the opinions offered by Dr. Engel on the Model. "To be reliable under *Daubert*, an expert's scientific testimony must be based on scientific knowledge" *Dodge v. Cotter Corp.*, 328 F.3d 1212, 1222 (10th Cir. 2003). The Supreme Court has explained that the term "scientific" "implies a grounding in the methods and procedures of science." *Daubert*, 509 U.S. at 590.

The Supreme Court has set forth four non-exclusive factors that a court may consider in making its reliability determination: (1) whether the theory or technique can be (and has been) tested, *id.* at 593; (2) whether the theory or technique has been subjected to peer review and publication, *id.*; (3) the known or potential rate of error and the existence and maintenance of standards controlling the technique's operation, *id.* at 594; and (4) whether the theory or technique has general acceptance in the scientific community, *id.* Importantly, the Supreme Court cautioned that the inquiry is "a flexible one." *Id.*; *see also id.* at 593 ("[m]any factors will bear on the inquiry, and we do not presume to set out a definitive checklist or test"); *Dodge*, 328 F.3d at 1222 ("the list is not exclusive").

Finally, the Supreme Court stated that it is not the conclusion reached by the expert, rather the methods used to arrive at the conclusion that are at issue: "The focus [of the inquiry]. . . must be solely on principles and methodologies, not on the conclusions that they generate." *Daubert*, 509 U.S. at 595. The Tenth Circuit has stated the same principle this way:

The plaintiff need not prove that the expert is undisputably correct or that the expert's theory is "generally accepted" in the scientific community. Instead, the plaintiff must show that the method employed by the expert in reaching the conclusion is scientifically sound and that the opinion is based on facts which sufficiently satisfy Rule 702's reliability requirements.

Mitchell v. Gencorp Inc., 165 F.3d 778, 781 (10th Cir.1999); *see also Truck Ins. Exchange v. Magnietek, INC*, 360 F.3d 1206, 1210 (10th Cir. 2004).

B. The Model satisfies all of the applicable *Daubert* reliability indicia.

As demonstrated below, the Model is reliable based on all of the applicable *Daubert* criteria.

1. **The Model was based on well-accepted hydrologic modeling theory and methodology that is part of the body of peer reviewed scientific literature for this scientific discipline.**

One of the factors suggested by *Daubert* to evaluate the reliability of an expert opinion is consideration of whether the expert's theory or methodology has "general acceptance" in the scientific community. While *Daubert* does suggest that "general acceptance" is a factor to be considered by a court, it is careful to note that "general acceptance" is not required under the federal rules. *Daubert*, 509 U.S. at 588-89. The passage of Federal Rule of Evidence 702 liberalized admissions criteria of expert opinions beyond the rigid "general acceptance" test announced in *Frye v. U.S.*, 293 F. 1013 (D.C. Cir. 1923). *Id.* Under the Federal Rules of Evidence, for an expert's testimony to be admissible, a litigant "need not prove that the expert is undisputably [sic] correct or that the experts theory is 'generally accepted' in the scientific community." *Mitchell*, 165 F.3d at 781 (citations omitted). Rather, a litigant must show only that the method used by an expert is scientifically sound and that the expert's opinion is based on sufficient facts to satisfy the reliability requirement of Rule 702. *Id.* See also *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 744-45 (3d Cir. 1994). The Third Circuit in *In re Paoli*, highlighting the "good grounds" requirement of *Daubert* noted that the reliability standard is lower than the merits standard of correctness. *Id.* Further, the Court noted that:

The grounds for the expert's opinion merely have to be good, they do not have to be perfect. The judge might think that there are good grounds for an expert's conclusion even if the judge thinks that there are better grounds for some alternative conclusion, and even if the judge thinks that a scientist's methodology has some flaws such that if they had been corrected the scientist would have reached a different result.

In re Paoli, 35 F.3d at 744. In the instant case, it is clear from the evidence provided that Dr. Engel's conclusions are drawn from scientific methods that are both "generally accepted" and based on "good grounds."

Defendants assert that the overall modeling methodology used by Dr. Engel is novel and litigation based, and they support this assertion based on the opinions of their retained expert, Dr.

Bierman. The State has previously filed with the Court a *Daubert* motion challenging the specific expertise of Dr. Bierman to offer an opinion on the Model and the type of hydrologic runoff modeling applied by Dr. Engel in this case. *See* DKT #2063. At the outset then, the weight given to Defendants' arguments attacking the Model should be discounted because those arguments were conceived by Dr. Bierman, a modeler who conceded:

- He had *no* experience with the GLEAMS model prior to this case, *see* Exhibit D (Bierman Depo. 84:13-23, 155:11-19, & 330:10-23), nor had he had any substantive prior experience with similar hydrologic runoff water quality modeling, *see* Exhibit D (Bierman Depo. 161:10-21 & 328:4-10);

- He had *no* opinion concerning and performed *no* evaluation of the possible phosphorous sources to the IRW, *see* Exhibit D (Bierman Depo. 56:16-57:1, 61:15-18, 63:3-11, & 143:8-2), nor had he conducted any evaluation of whether any of the particular phosphorous sources Defendants claim Dr. Engel should have included in the Model have any importance in the IRW, *see* Exhibit D (Bierman Depo. 196:8-198:11, 300:23-301:6 (urban runoff), 344:7-18, 346:10-347:11, 367:7-20 (land-applied biosolids));

- He did *no* study of how and when poultry litter is applied in the IRW. *See* Exhibit D (Bierman Depo. 89:4-8 & 335:24-336:22);

- He performed *no* sampling or detailed field investigations of the IRW. *See* Exhibit D (Bierman Depo. 85:22-86:11);

- He did *no* investigation or analysis of how soil phosphorous level (soil test phosphorous or "STP") affected phosphorous levels in runoff waters in the IRW. *See* Exhibit D (Bierman Depo. 112:22-113:3). Nor has he evaluated and formed any opinion as to whether STP levels in IRW soils have increased over time. *See* Exhibit D (Bierman Depo. 113:12-114:7);

- He did *no* study of climate and its effects on delivery of phosphorous in IRW rivers and streams. *See* Exhibit D (Bierman Depo. 226:23-227:3). Nor did he evaluate how climate information influences the Model. *See* Exhibit D (Bierman Depo. 382:25-386:3 & 385:4-20);

- He has *not* studied the affects of urban runoff on nutrient loadings in watersheds. *See* Exhibit D (Bierman Depo. 232:1-9 & 235:1-10); and

- Significantly, he performed *no* modeling work of his own to determine if *any* of Defendants' criticisms of the Model would have *any import whatsoever* on the modeling results. *See* Exhibit D (Bierman Depo. 237:9-239:18).

This total lack of evaluation and verification by Defendants' retained expert in these important subjects that would support their criticisms of the Model, coupled with Dr. Bierman's lack of expertise, indicate that Defendants' *Daubert* motion concerning the Model lacks any foundation in fact or scientific method.

As noted above, the Model, which is a combination of GLEAMS and an empirical routing equation or model,² was selected by Dr. Engel because, based on his extensive knowledge and experience, it would best and most reliably describe the conditions in the IRW that were investigated based on the modeling goals. *See* Exhibit C (Engel Decl. ¶ 7). It is also without doubt that GLEAMS has been used by many investigators in the past and its use is well described in the peer reviewed scientific literature. For example, Dr. Engel explains that GLEAMS is a well-established hydrologic/water quality model with which he has extensive experience and provides many applications documented in the peer reviewed literature. *See* Exhibit C (Engel Decl. ¶ 9).

Similarly, GLEAMS can and has been linked to other models in order to perform a watershed-wide study such as that performed by Dr. Engel with the Model. *See* Exhibit C (Engel Decl. ¶ 10) (describing many applications discussed in the scientific literature where GLEAMS has been used to study a watershed in the same fashion as that used by Dr. Engel).

Thus, the Model may be linked to a process-based mechanistic model or to an empirical-routing equation model to study a watershed such as the IRW. Dr. Engel chose the empirical-routing equation model to link with GLEAMS. The empirical-routing equation models are valid

² Computer-driven hydrologic models (such as GLEAMS) are commonly used in environmental studies. These models are essentially mathematical equations that employ coefficients to describe the modeled processes. The coefficients are based on observed data either from the system being modeled or other similar systems. The routing "equation" is a "model" that employs mathematical equations that describe actual, observed conditions in the IRW.

and reliable methodologies for hydrologic water quality modeling and are often used in the place of mechanistic-type models. *See* Exhibit C (Engel Decl. ¶ 11). Indeed, Dr. Engel has provided numerous citations demonstrating the wide and accepted use of empirical-routing equation models. *See id.* Dr. Engel explains that the *advantage* of these empirical models is that it eliminates the many *assumptions* that are necessary with a mechanistic model and replaces the assumptions with actual observations. *See id.*

Thus, all of the experts in the field of hydrologic runoff modeling agree that the use of GLEAMS with a routing model as done by Dr. Engel in his IRW study has been generally accepted by the relevant scientific community. Indeed, Dr. Chaubey, a respected researcher and non-retained expert who has specifically investigated and published in the area of nonpoint source pollution in the IRW has stated: “You can interface the GLEAMS model, which is a fields scale model, with the routing model, to represent watershed processes and use that to answer these type of question.” * * * “... it’s done all the time.” *See* Exhibit E (Chaubey Depo. 72:12-24 & 230:12-9).³

Defendants also contend that the methods or techniques used by Dr. Engel to allocate phosphorous among IRW sources are also novel and were “used for the very first time in this litigation.” *See* Defendants’ motion pp. 9-10. This assertion is false and, not surprisingly, Defendants cite no authority that supports this claim. Again, in his declaration, Dr. Engel describes many examples from peer reviewed publications where the allocation techniques his employed have been used by others. *See* Exhibit C (Engel Decl. ¶¶ 12-13). Again, a non-

³ Even Dr. Bierman, Defendants’ retained expert, acknowledges that the Model methodology (adding a routing model to the GLEAMS model) was a practice that has been used and discussed in the peer reviewed literature. *See* Exhibit C (Bierman Depo. 169:18–170:18). Nor does he contend that there is anything wrong with the GLEAMS model itself. *See id.* Apparently, Dr. Bierman concedes the overall reliability of the methods used by Engel; he just disagrees with its site specific application to the IRW. *See id.* The merits of those criticisms are evaluated below.

retained expert who is familiar with modeling the IRW and the models employed by Dr. Engel corroborated Dr. Engel's allocation technique and his application of the technique to the IRW. *See* Exhibit F (Storm Depo.73:14-74:3 & 224:18-227:11).

Undoubtedly then, the underlying theory and methodology on which the Model is based, as well as the allocation methodology employed by Dr. Engel, are generally accepted by the scientific community and meet this "acceptance" criteria of *Daubert*. *See* Exhibit C (Engel Decl. ¶ 15). This modeling and allocation theory and methods are neither novel nor were they created for this litigation.

2. The underlying scientific theory and methodology was reliably applied in the Model's development and application to the IRW.

Defendants' *Daubert* challenge is focused mainly on the method of implementation of the Model. Again, the underlying scientific theory and methodology were reliably applied in the Model's development and application to the IRW. As noted in above, Dr. Engel has carefully and fully documented the fact that when he applied the GLEAMS model in combination with the empirical routing model, he did so consistently with established practiced and standards set forth in the peer reviewed literature. Exhibit C (Engel Decl. ¶¶ 9, 10, 11, 19, 26, and 27). Indeed, before the Model was developed, Dr. Engel developed a written protocol "that was used to guide the overall modeling effort as well as to determine which sources of phosphorous to include in the evaluation." Exhibit C (Engel Decl. ¶ 16). Importantly, not only did Dr. Engel follow the large array of peer reviewed literature when he applied the selected methodology, he also followed the standards that he and others have published in the peer reviewed literature that recommend hydrologic water quality modeling application protocols. *See* B. Engel, D. Storm, M. White, J. Arnold, M. Arabi, A Hydrologic/Water Quality Model Application Protocol. *Journal of American Water Resources Association* 43(5):1223-1236 (2007); and Exhibit C

(Engel Decl. ¶ 16). The specific application errors argued by Defendants are similarly without merit.

Defendants' challenges appear to be centered on the following complaints: (1) the Model did not consider all sources of phosphorous and in any event, the allocation is flawed; (2) that Dr. Engel did not have a written protocol; (3) Dr. Engel's assumptions concerning litter application are "off the mark"; and (4) the modeling scenarios investigating future effects of land application were not "real."

Before addressing these specific complaints, however, it should be pointed out that Defendants and their retained expert, Dr. Bierman, rely heavily on two documents that they suggest is EPA guidance that is applicable to the Model and refer to a non-reviewed Internet paper as representing the views of world-renowned water quality modelers. As pointed out by Dr. Engel, the EPA Guidance provides general suggestions for environmental modeling in general and the guidance contains an up-front disclaimer that the Guidance does not impose legally binding requirements, does not apply to all modeling circumstances, and, indeed, the EPA retains discretion to use different approaches. Exhibit C (Engel Decl. ¶¶ 8 & 16). With respect to the SERA-17 paper, the paper is not published in a peer reviewed journal, and is authored by persons with limited experience in hydrologic/water quality modeling. Exhibit C (Engel Decl. ¶ 17). To the contrary, Dr. Engel has recently published a peer reviewed article on the application of protocols for this type (*see* Engel et al., 2007), and Dr. Engel has published more than 110 peer reviewed papers discussing modeling issues. Exhibit C (Engel Decl. ¶ 3).

a. Dr. Engel's evaluation of sources and allocation

As noted above, Dr. Engel employed a written protocol that was followed to determine sources. This protocol ensured that any phosphorous source of significance was identified and

considered by the Model. Exhibit C (Engel Decl. ¶¶ 16&18). This protocol and its application considered more of the same sources considered by other IRW investigators that have published their results. *See* Exhibit C (Engel Decl. ¶ 18). Defendants complain that stream bank erosion, septic tanks, sewage bypasses at treatment plants and commercial fertilizer imported into the IRW are sources that were ignored. However, Dr. Engel considered all of these sources, by way of his mass balance analysis and other means, but they were rejected for logical reasons. *See id.* Most were considered to be too small to be of any consequence. For example, stream bank erosion does not add any phosphorous unless it has been impacted by the application of animal wastes or fertilizers. *See id.* Septic tanks were evaluated and were found to be a minimal phosphorous contributor. *See* Exhibit B (Engel report App. D&G) (Dr. Engel's expert report DKT #2056-3, 4, 5, & 6 is being reproduced because Defendant's copy is incomplete, contains undisclosed handwritten notes, is not produced in color allowing for clarity in charts and graphs and is not in searchable format) and Exhibit C (Engel Decl. ¶ 18). Dr. Storm's analysis of IRW sources concurs with this conclusion. *See* Exhibit F (Storm Depo. 74:11-19). Defendants' own retained expert Dr. Jarman found that sewage bypasses accounted for only 100 pounds of phosphorous a year and commercial fertilizers were considered as part of Dr. Engel's mass balance. *See* Exhibit B (Engel report App. D) and Exhibit C (Engel Decl. ¶ 18).

Perhaps, the most telling factor undermining Defendants' concern about missing sources is the fact that neither they nor their expert, Dr. Bierman, performed any analysis or provided any evidence of relative phosphorous contributions to the IRW. Dr. Bierman has *no* opinion concerning and performed *no* evaluation of the possible phosphorous sources to the IRW. *See* Exhibit D (Bierman Depo. 56:16-57:1, 61:15-18, 63:3-11, & 143:8-2). Dr. Bierman has *not conducted any evaluation* of whether any of the particular phosphorous sources Defendants

claim Dr. Engel should have included in the Model have any importance in the IRW. *See* Exhibit D (Bierman Depo. 196:8–198:11, 300:23–301:6 (urban runoff), 344:7–18, 346:10 – 347:11, 367:7–20 (land-applied biosolids)). Finally, Defendants are misleading when they claim on page 13 of their motion that Dr. Engel’s previous testimony before the Court as a Special Master would impinge his current opinion. In fact, the testimonial criticism referenced by Defendants concern the failure to include swine by the investigator in the *City of Tulsa* case. *See* Defs.’ Motion, Exhibit 3, pp. 460–61. What is not mentioned by Defendants is that swine were specifically included in Dr. Engel’s analysis. *See* Exhibit B (Engel report, pp. 92–93).

Defendants’ allocation complaints are similarly without substance. As noted above, the allocation techniques employed by Dr. Engel are well recognized. *See* Exhibit C (Engel Decl. ¶¶ 12, 13, & 32) & Exhibit F (Storm Depo. 73:14–74:3 & 224:18–227:11). Furthermore, the allocation analysis by Dr. Engel using the Model was consistent with the phosphorous mass balance he performed. *See* Exhibit B (Engel report App. B) and Exhibit C (Engel Decl. ¶ 35). Moreover, the Model allocation also produced a consistent allocation with the allocations performed by other IRW investigators using different techniques. *See* Exhibit C (Engel Decl. ¶¶ 36–37); *see also* Exhibit C (Engel Decl. ¶ 33) (where Dr. Engel explains his method of analysis of source allocation for point sources).

Specifically, Defendants complain that Dr. Engel’s allocation to poultry and cattle in the IRW is inconsistent with the results obtained by non-retained expert Dr. Storm. These claims are bare bones misrepresentations. With respect to the poultry allocation, Defendants know that Dr. Storm and Dr. Engel have similar conclusions because they took Dr. Storm’s deposition in that case. In the deposition Dr. Storm explained that his poultry allocation is consistent with Dr. Engel’s poultry allocation because both reach a similar conclusion for contributions based on

current year land application (which is all that Dr. Storm considered), but Dr. Engel went on to evaluate the *total* poultry contributions by including with the current year land application the contribution from soils with increased STP (and resultant increased phosphorous runoff). *See* Exhibit F (Storm Depo. 38:20–40:14) and Exhibit C (Engel Decl. ¶ 34).

Defendants' cattle allocation is similarly unsupported. Dr. Engel, as well as other IRW investigators (including Dr. Storm), agree that IRW cattle do not add significantly to the IRW phosphorous (unlike poultry who are fed feeds that are imported into the IRW and supplemented with phosphorus); cattle only facilitate some phosphorous movement to the rivers and streams. *See* Exhibit F (Storm Depo. 224:18–226:4) and Exhibit C (Engel Decl. ¶¶ 20-21, & 42). Again, Defendants' claim of a difference is actually another point of validation for Dr. Engel's work.

Finally, Defendants cite *City of Wichita v. Trustees of APCO Oil Corp. Liquidating Trust*, 306 F. Supp. 2d 1040, 1109-10 (D. Kan. 2003), claiming that the court excluded the expert testimony because not all sources were considered. In *City of Wichita*, there were several reasons the court excluded the expert's testimony, none of which apply in this case. Indeed, the court did not base its decision to exclude on a claim that not all sources were considered. The basis for exclusion was the admission that the expert deviated from his original modeling methods and was inconsistent in his application. *Id.* at 1109-10. This is simply not the case here. Dr. Engel's methods were laid out in Appendix D to his report and followed. *See* Exhibit B (Engel report, App. D). Second, Defendants cite *Kalamazoo River Study Group v. Eaton Corp.*, 258 F. Supp. 2d 736, claiming that it discusses the importance of analyzing alternative sources. In *Kalamazoo*, the plaintiff was a PRP seeking contribution under CERCLA for remediation costs, and, as such, the only issue was allocation to sources. *Kalamazoo River Study Group v. Eaton Corp.*, 258 F. Supp. 2d at 739 (W.D.Mich. 2002). Here, the issue is whether

Defendants are substantial contributors, and identification of every *de minimus* source of phosphorous is not required to assess liability. In fact, because the Court in *Kalamazoo* never even undertook a *Daubert* analysis, any statement made by the Court in that case concerning an allocation of sources certainly should not be interpreted as a requirement to meet the *Daubert* factors.

b. Dr. Engel did have a written protocol

Defendants also complain that Dr. Engel did not follow a written protocol developing the Model. This is also demonstrably false. Appendix D to Dr. Engel's report contains his modeling protocol. *See* Exhibit B (Engel report, App. D). In his Declaration Dr. Engel explains how he developed the protocol and how it was used in the Model development. *See* Exhibit C (Engel Decl. ¶¶ 7, 16, 18, 19, 28, 32 and 39).

c. Dr. Engel's assumptions concerning waste application are reasonable

Defendants complain on page 15 of their motion that Dr. Engel's assumptions with respect to when, where and how poultry waste is applied are unreasonable. First, it is noteworthy that Defendants have no studies of their own nor cite any contrary evidence that Dr. Engel's assumptions were either wrong or that the assumptions had a material effect on the Model output. Dr. Bierman testified that he did *no* study of how and when poultry litter is applied in the IRW, *see* Exhibit D (Bierman Depo. 89:4-8 & 335:24-336:22), and he did *no* investigation or analysis of how soil phosphorous level (soil test phosphorous or "STP") affected phosphorous levels in runoff waters in the IRW, *see* Exhibit D (Bierman Depo. 112:22-113:3). Nor did he evaluate and form any opinion as to whether STP levels in IRW soils have increased over time. *See* Exhibit D (Bierman Depo. 113:12-114:7). Defendants can make no valid claim without evidence to support it. On the other hand, Dr. Engel relied on studies he and Dr. Fisher

made of such practices, as well as the reports of other investigators. *See* Exhibit B (Engel report pp. 12-23) and Exhibit C (Engel Decl. ¶¶ 22, 23, and 24). Also, Dr. Storm made similar assumptions modeling the IRW. *See* Exhibit F (Storm Depo. 107:9–108:14, 133:15-135:23, 138:4-22). Finally, it is also odd that the Defendants would be critical of Dr. Engel's assumptions since they have uniformly disclaimed any knowledge or control of the methods and means of poultry waste disposal.

d. The modeling scenarios investigating future effects of land application were reasonable and followed standard practices.

Defendants complain that Dr. Engel made wild assumptions when he modeled the effects of changes to poultry waste application practices. Of course, this again is speculation on Defendants' part because they have no analysis of their own or peer reviewed authority to support this assertion. Dr. Bierman did *no* study of climate and its effects on delivery of phosphorous in IRW rivers and streams nor did he evaluate how climate information influences the Model. *See* Exhibit D (Bierman Depo. 226:23-227:3, 382:25-386:3 & 385:4-20). On the other hand, Dr. Engel reasonably explains the logic behind how the modeling of future land use scenarios was performed and that this technique has been recognized in the peer reviewed literature. *See* Exhibit C (Engel Decl. ¶¶ 14 & 25).

In sum, Defendants' claimed flaws in modeling application have no basis in law, logic, or fact and are unsupported by any evidence and are merely hollow rhetoric. Dr. Bierman candidly admitted that he had performed *no* modeling work of his own to determine if *any* of Defendants' criticisms of the Model would have *any import whatsoever* on the modeling results. *See* Exhibit D (Bierman Depo. 237:9-239:18).

3. The Model is capable of being tested and has been tested.

Often important to the reliability analysis is the question as to whether the method or technique can be tested. As noted by the *Daubert* Court, scientific method today is based on testing of hypothesis and empirical testing. *Daubert* 509 U.S. at 593. The Model is not only capable of being tested; it has already been tested by two methods – calibration and validation.

Defendants do not contend that the Model was not capable of testing. Thus, it plainly satisfies one part of the *Daubert* analysis -- whether the theory or technique can be (and has been) tested. *Id.* As discussed in his Declaration, Dr. Engel tested the model through calibration and validation in the same way others in the peer reviewed literature have tested the same models. *See* Exhibit C (Engel Decl. ¶¶ 28, 39). Defendants could have tested the Model themselves, but they chose not to. Nevertheless, Defendants still complain about some specific calibration issues that can be readily dispensed with.

For example, Defendants contend (without any analysis or evidence) that calibration should *also* be performed at the edge of fields as well as at the gauging stations. As explained by Dr. Engel, this is unnecessary based on published peer reviewed literature. *See* Exhibit C (Engel Decl. ¶ 29). Similarly, Defendants also claim that the Model should have been calibrated for sediment, and they cite as support the testimony of the State's lake modeler, Dr. Wells. This argument is at best amusing and at worst another misrepresentation. Dr. Wells' opinion that the sediments are important related to the sediments on the bottom of Lake Tenkiller, not sediments suspended in the Illinois River. *See* Exhibit C (Engel Decl. ¶ 29). Dr. Engel also explains that sediments do not have to be separately calibrated, because the sediments were considered as part of the total phosphorous calibrated in the Model. *See* Exhibit C (Engel Decl. ¶ 30). Sediment

entrained phosphorous that is suspended in water is included as a component of the total phosphorous analysis of IRW surface water samples.

Finally, the sensitivity analysis concern of Defendants had no impact on the results and was not required. As demonstrated by Dr. Engel, Defendants' own authority that they cite does not support their position that a sensitivity analysis is required in all cases or, more particularly, in this case concerning the Model. *See* Exhibit C (Engel Decl. ¶ 30). Sensitivity analysis is typically performed when there is some question by the modeler and the modeling community as to how the model typically performs in circumstances similar to those being modeled. *See* Exhibit C (Engel Decl. ¶ 30). Given the extensive use of the GLEAMS model reported in the peer reviewed literature (so how it performs is well established) and Dr. Engel's experience with the GLEAMS model, sensitivity analysis is neither required nor important. *See* Exhibit C (Engel Decl. ¶ 30). Consequently, the Model can be and has been tested, and Defendants' concern for additional tests is unsupported.

4. The Model methods and application are supported by the peer reviewed literature.

Another aspect or test of reliability listed by the Supreme Court in *Daubert* is peer review and publication of the method. As demonstrated in the forgoing discussion and by the multiple citations of peer reviewed publications set forth in Dr. Engel's Declaration, both the theory and methodology of the Model, as well as the application of such theory and methodology in this case, are well supported by the peer reviewed scientific literature. *See* Exhibit C (Engel Decl. ¶¶ 9-16, 18-21, 24-28, 30, 32, 34, 36-37 & 39). This material identifies numerous peer reviewed articles that employ the same methods as the Model and identify many other IRW investigators whose work confirms the Model results and analysis.

5. The Model has standards that control its operation.

The final applicable reliability consideration expressed in *Daubert* concerns whether the method has standards that control its operation. As discussed above, the methods, techniques, and their application for the Model have all been recognized in the scientific literature. Also, Dr. Engel recently published an article on modeling standards, which he has reliably followed. *See* Engel et al., 2007). Finally, as discussed above, Dr. Engel drafted a written protocol based on these standards and followed the protocol in his model development. *See* Exhibit B (Engel report, App. D) and Exhibit C (Engel Decl. ¶¶ 7, 16, 18-19, 28, 32 and 39).

In sum, the Model easily meets the *Daubert* reliability criteria.

6. Defendants' arguments based on the Errata, their "utility" test and Dr. Jeon.

Defendants also take issue with Dr. Engel's errata. An expert's errata have no bearing on the admissibility of their report. The U.S. District Court for the Southern District of Ohio stated:

Daubert does not require that an expert's testimony be excluded simply because he admitted and corrected his own mistakes or retracted his false statements. In fact, one of the very purposes of a *Daubert* hearing . . . is to give experts a chance to explain and even correct errors that they made in their reports. ***There is no stigma attached to such error correction, nor should there be. If anything, it strengthens the quality of the expert report.***

Crowley v. Chait, 322 F. Supp. 2d 530, 540 (S.D. Ohio 2004) (emphasis added). Similarly, when faced with an issue of an expert correcting errors in his report, Judge Rasure of the U.S. Bankruptcy Court for the Northern District of Oklahoma held: "when mistakes are made, caught, corrected and ***satisfactorily*** explained by the expert in a supplemental report, as ***required*** by the Rule 26(e), no adverse inference as to the reliability of the expert's opinion need be drawn." *In re Commercial Fin. Servs., Inc.*, 350 B.R. 520, 558 (Bkrtcy. N.D. Okla. 2005) (emphasis added). Finally, it is also important to note that despite any perceived errors claimed by the court or opposing counsel, so long as an expert's testimony rests on good scientific grounds, it should

still be admitted. *See In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 744-45 (3d Cir. 1994) (holding that so long as an expert's opinion is based on good grounds it must be admitted despite the fact that, "[t]he judge might think that . . . a scientists methodology has some flaws such that if they had been corrected the scientist would have reached a different result"). Because Dr. Engel's errata were required, and per Rule 26(e) no stigma can be attached to his testimony for making such corrections, his opinion should be admitted.

Defendants also claim that their expert, Dr. Bierman, performed a test on the Model that shows it is unreliable. *See* Defendants' motion, pp. 20-21. This expert-constructed argument demonstrates again the lack of Defendants' expert's understanding of hydrologic water quality models and Defendants' desperate attempt to find criticism with Dr. Engel's work. To perform their "test," Defendants concocted a scheme whereby the *empirical* model used by Dr. Engel in his analysis that is based on IRW observations would be tested by changing the observed to fanciful inputs, but not change the empirical model equation. As Dr. Engel logically points out:

The inputs to the routing model used by the Defendants' expert Dr. Bierman do not represent the conditions in the watershed when the actual phosphorous loads were observed and thus violate the conditions to which the model should be applied. If the inputs used by Dr. Bierman represented the conditions in the IRW, the observed P loads would have been different, and therefore the routing model would have been different.

See Exhibit C (Engel Decl. ¶ 40). By doing this test, Defendants violated a fundamental rule of empirical models and revealed that they are searching for an argument where none exists.

Finally, Defendants wring their collective hands over Dr. Engel's employment of a post doctorate modeling professional to assist him in his work. Almost all of the experts in this case (on both sides) received assistance with their work. As explained by Dr. Engel, Defendants' criticisms of Dr. Jeon are also unfounded. Dr. Jeon has more experience in the area of hydrologic water quality modeling than Dr. Bierman. In any event, Dr. Engel was fully involved

in all aspects of the Model so that he was responsible for the development, and use of the Model.

See, Exhibit C (Engel Decl. ¶ 43).

III. Conclusion

All of the *Daubert* factors weigh in support of reliability of the Model. The State requests that the Court deny Defendants' motion in all respects.

Respectfully Submitted,

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